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FOUND LINKS.

BY DR. ANDREW WILSON, F.R.S.E., F.L.S.

(*Concluding Paper.*)

NOW, as regards the past history of the Mammalia, there exists abundance of evidence to show that many extinct quadrupeds stand in relation to these existing orders in the light of "intermediate forms" or "links." The recent researches of Professor Marsh amongst the American fossil mammals have been fraught with literally surprising results in this latter direction. Prior, however, to Marsh's discoveries, there were not wanting facts which pointed to the conclusion that the demands of evolution for links between the existing orders of quadrupeds would not be made in vain. Take for example the single order of the Whales. No more circumscribed and apparently distinct group of animals exists, yet their relationship to other orders of quadrupeds is no mere matter of conjecture, but one of proof. There is a fossil whale known as *Zenglodon*, found in Tertiary deposits, and so named from the peculiar double-nature of the molar teeth. Whales with such teeth are unknown to-day, and when the affinities of Zenglodon are examined, they are seen to point to a clear connection with the Seals and Walruses, belonging as we have seen to the *Carnivora*. It would thus seem as if the natural idea that the Seals and Whales were near relations was founded on fact; and fossil whales certainly tend to bridge over the gulf betwixt the two groups. But this case, powerfully as it argues in favour of the connected series of animals which evolution requires, is by no means solitary. We have long known, for example, of the *Anoplotherium*, an extinct quadruped, which presents in itself a curious mixture of the characters of Pigs and Ruminant animals, *i.e.*, those that "chew the cud," and comparative anatomists will tell us that the pigs and hippopotamus group themselves show, in many respects, an approximation to the Ruminants. Or to take yet another example from Cuvierian times, we find in the *Palæotherium* an animal which links the Tapirs to the Horses, and which shows a combination of characters that amply satisfies the evolutionist of its "intermediate" nature.

But the more recent discoveries of Marsh throw the foregoing cases into the shade in respect of the mass of material which that indefatigable palæontologist has accumulated. Thus we have been forced to constitute a whole series of new orders for the reception of the forms Professor Marsh has unearthed. What, for instance, shall we say of the extinct *Dinoceras* and its neighbours? These huge elephantine animals united in themselves the characters of Elephants, and of odd-toed "hoofed" quadrupeds. With limb-bones like those of Elephants, *Dinoceras* possessed teeth that exhibited a combination of the characters of carnivorous animals with those of "hoofed" forms. More extraordinary still were the *Tillodonts* from the Eocene rocks of the United States. Here are combined the features of hoofed quadrupeds (*ungulata*), *Carnivorous* animals, and *Rodents*. With a skull like that of a Bear, *Tillotherium* possessed front teeth exactly resembling those of the Rodents, or "Gnawers," and which appear to have combined to grow throughout the life of the animal, whilst the grinding-teeth were those of a hoofed animal. So, also, another group of extinct animals, of which *Toxodon* is the chief, presents us with a combination of characters mingling those of the "Hoofed" forms with those of Rodents and Edentates—such as the Sloths, Anteaters, &c.

As a final example of the curious "links" between existing forms, which may be found amongst the treasures disclosed by scientific inquiry, the curious "Flying Lemurs" (*Galeopithecus*) may be mentioned. These animals are found in the Eastern Archipelago, and resemble Squirrels in appearance. A curious fold of skin stretches from the sides of the neck to the fore limbs, and between hind-limbs and tail. The body is thus fringed, as it were, by a broad fold of skin, and although, unlike the bats, the flying lemurs do not possess true powers of flight, the skin-folds serve as a kind of parachute, supporting these animals in the air, as they take their flying leaps from tree to tree. In their internal anatomy these animals exhibit transitional features, and on the whole may be regarded as linking the Insectivora with the higher group of the Primates in which Man and Apes are included. Whilst it seems tolerably clear that the Bats themselves are merely Insectivorous animals which have undergone the modifications fitting them for true flight.

Such is a brief and meagre outline of the result of an incursion into the province of geology as that science relates itself to the past history of living forms. In concluding the series of papers on "Found Links," I may perhaps be permitted to add that the design of these articles will have been fully served, if they may in any way stimulate the personal inquiries of my readers into the great study of modern times, namely, that of ascertaining how the universe of life has been modified and evolved. Such a study is fraught with profit in more ways than one. The search after evidence in favour of or against Evolution necessitates an amount of inquiry which is certain to strew the observer's pathway with curious facts concerning every department of life-science. Furthermore, the main question at issue is one which in reality underlies all our conceptions of life, and of the order of nature. It is the question which the best and wisest of mankind have ever asked and inquired of themselves—the How, Why, and Whence of this world and its belongings. Happy indeed are they who, in the spirit of earnest truth-seekers, are permitted to engage in the work of discovering new facts and phases of the wondrous story of creation, which Nature is ever inviting us to peruse.

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THE RELATION OF EXERCISE TO BRAIN-WORK.

RECENT numbers of the London *Spectator* have contained very interesting communications on this subject. Nothing like a general rule can be evolved from them, because individual temperament, employment, and circumstances create an endless variety of cases that no rule could cover. The more witnesses, however, the greater the chance that the inquirer will find a hint suitable to himself, and it is every one's experience that such hints often determine the happiness of a lifetime. The author of "The Duties of Women," a great believer in physical exercise, thinks that it "need not and cannot well be taken on the same days when the heavy mental work has to be done." Mind and body may best be strained alternately by days or by seasons. Especially does she hold that every woman should provide for some perspiring exercise—"a natural Turkish bath"—at short intervals. An Oxford man advocates pleasurable *change* as the chief element of recuperation, more important than the muscular exercise; for which reason he prefers horseback and bicycle riding to walking. His rule is—"One hour of some thoroughly good form of exercise every day, and every week several additional hours' 'change.'" Another contributor has "uniformly found that reducing the diet, and especially avoiding the too free use of heat-producing foods, if not an equivalent for the lack of exercise, at any rate enables one to pursue one's desk-work in comfort, with efficiency, and without harm accruing." No doubt there is sense in all these suggestions, and some are within the reach of everyone. We should ourselves lay stress on the advantage of a thorough gymnastic training as the basis of all subsequent modes of exercise. The muscular tone of the system, once established in this way, can be maintained with a minimum of effort and time by the chamber use of clubs, dumb-bells, or even simpler contrivances. The back, the chest, and the abdominal organs, which are the chief sufferers from sedentary pursuits, can thus be directly addressed in the countervailing exercise. If to this can be added a short half-mile run in the open air, the account will generally be found squared daily for any but exhausting mental exertion. The rule, *Impletus venter non vult studere libenter*, is, of course, as good for exercise as for brain-work. Beyond this, it is hazardous to dogmatise. Some cannot safely take a long walk on an empty stomach, or before breakfast; to others, nothing is easier, more exhilarating, or apparently more harmless. Some walkers have only rambling thoughts while on the road; others do their best and closest thinking under such circumstances. Rousseau belonged to the latter class: his mind needed the motion of the body to stimulate it to its utmost. Yet he was not jaded by this two-fold activity, and was, moreover, alive to the passing beauties of the scene: he did not overlook the wayside periwinkle. With some the morning and daylight hours are best for intellectual performance; others require the silence of the small hours of the night. Anyone who can order his habits to suit his idiosyncracies, physical and mental, has no excuse for running down from lack of proper exercise or from over-exercise. Among all the felicities of Darwin's life, this ability was certainly one of the most enviable and the most profitable for mankind.—From the *Nation*.

Buoying the Electric Light.—A large iron buoy was recently towed from the Government works at Tompkinsville, Staten Island, to the lower bay, where it is to be used to support an electric light.

THE AMATEUR ELECTRICIAN.

ELECTRICAL MEASUREMENT.—I.

IT is only natural that before we attempt to measure a substance, we should inquire what that substance is. Generally speaking, we can answer such a question. We can say that we have a pound of potatoes, that a potato is a vegetable product, and occupies space. We can see it, feel it, taste it. We can say that the potato is so many inches in circumference, or that it displaces a greater or less quantity of water. Not so with electricity. It requires no argument to demonstrate that we can get neither a pound, a pint, or an inch of it. All substances that can be so measured are ponderable, have a definite chemical constitution, and are in many cases visible. Electricity, on the other hand, is invisible, inodorous, tasteless, and imponderable. The weight of a mass of metal, &c., is not increased or decreased by charging it with electricity.

If, then, electricity has neither of the properties by which material substances are measured, we must ascertain what properties pertain to it which are available for rendering measurement possible. It is assumed that all are acquainted with the fundamental differences between force and matter; that whereas matter embraces everything which has weight, force may be said to be a condition of that matter, or that which will produce a change in matter. It follows that to measure a force, we can only do so by studying its effects on matter. Thus we speak of heat as being sufficient to convert ice into water, water into steam, &c. Similarly, we may measure electricity by its capacity for producing chemical changes, deflecting magnetic needles, generating other forces (light, heat, &c.), and so forth.

Electricity, then, possessing all the general attributes of those forms of force with the effects of which we are well acquainted, we may fairly maintain that it also is embraced in that classification. To measure this force it is necessary to say first a few words on its production. It is known to most people of general scientific intelligence, that if a piece of glass is rubbed with a piece of flannel, or if two pieces of metal are connected and immersed in acidulated water, an electric current is generated, or if the junction of two pieces of metal is heated, or if a magnet is moved in a coil of wire, we get electricity. But it would not be difficult to find that many other changes in the physical world are accompanied by a more or less active display of electricity. In fact, turn where we may, electricity shows itself, and recent discoveries seem to indicate in no very uncertain sounds that every movement, whether it be of the mass or the particle, whether it be chemical or physical, is accompanied by a greater or less development of electricity.

We shall use the ordinary galvanic battery as the method of producing the electricity which we are about to measure.

The strength of a current varies according to the circuit through which it passes, but the first feature necessary for us to understand is its *potential*. Potential is that property of electricity which determines its motion from one point to another. Thus the power it has to overcome resistance, to leap across air in the form of a spark, to burst through the gutta-percha covering of a wire—in fact the power it has to form a current, is its potential. We may compare it to force with which high-pressure steam in a closed vessel persistently endeavours to escape. If two bodies at the same potential be connected with each other by some conducting medium, such as a wire, nothing will occur, but if one be at a higher potential than the other, a

current will pass through the conductor, and so equilibriate the two potentials. It is as impossible to say what this potential is due to, as it is to assign a cause for chemical affinity. All we can do is to say it exists, and that to a considerable extent it is governable.

It is commonly accepted that if we plunge a red-hot iron ball into water, both the water and the iron endeavour to impart heat one to the other in proportion to their respective temperatures, until ultimately equilibrium is attained, when no further transmission of heat takes place. Now we should be able to see that when the water and the iron have arrived at the same temperature, no further change will take place, or, in other words, equilibrium is established, which will endure until a third body at a different temperature is introduced, or until the temperature of one of them can be raised or lowered. There must, then, be a difference of temperature to produce what we may venture to call a "flow of heat." A close analogy may be observed in electricity. A conductor connecting two bodies at different potentials is traversed by a current the intensity of which is equal to the difference between the potentials, and this difference is called the *electro-motive force.*

HOME CURES FOR POISONS.

MERCURY, in the metallic shape, often, perhaps generally, passes through the body without producing any harm, but it is not so safe to take it as many, judging from such cases of immunity, imagine, for it may become oxidised, and cause serious mischief in that form. However, the risk from mercury in this form, or applied as a metal to the skin, need not occupy much of our attention, since there are few persons so foolish as to try experiments from which no good can conceivably result, and serious harm may.

The chief forms in which mercury may be taken so as to produce poisonous effects are the two chlorides — corrosive sublimate (formerly known as the bichloride, per chloride, or oxymuriate of mercury), and calomel, the subchloride or dichloride of mercury. Cinnabar, or vermilion, the red sulphide of mercury, is also poisonous, but it is not likely to occasion any domestic anxieties.

When the use of mercury in any medicinal form, but especially the corrosive sublimate, has been continued too long, or in too large doses, the system suffers in several characteristic ways. The brain and spinal chord are in a special manner affected, and serious diseases of the brain have been known to follow. The limbs tremble and quiver, and the tissues show a morbid sensibility which is very readily recognised. The secretion from the skin is abundant, and the salivary glands, becoming irritated, pour out large quantities of saliva. When poisonous doses have been taken, the effects on the salivary glands are not so conspicuous, and indeed are often not noticed at all. In severe cases, the symptoms then resemble very closely those observed in cases of arsenical poisoning, only they come on more quickly. An intense constriction of the throat is a marked feature of severe cases; violent vomiting and pains in the pit of the stomach are nearly always noticed.

Antidotes for mercury are selected with the object of preventing or limiting, as far as possible, its local action. Corrosive sublimate has the power of combining with albuminous substances, and therefore, when swallowed, abstracts albumen from the coats of the stomach. In the process calomel is formed. The poisonous action results from this combination with the albumen of the stomach. Therefore, to prevent or limit the poisonous action, albumen must be supplied from without. If white of egg, which is pure albumen, be taken into the stomach in good time, the coats of the stomach will be preserved from injury. According to Orfila, the proper proportion is the white of six eggs to half-a-pint of water. Decoction of bark or gall-nuts may also be used with advantage. If the pains have become intense before such remedies have been tried, we must assume that the poison has already acted injuriously upon the coats of the stomach. In this case, only a medical man can be trusted to suggest suitable remedial measures, the action of which will usually be more or less tedious. Warm baths, diluent drinks, and a diet of milk and farinaceous food, are suitable when the stomach has been thus injured. But usually medical advice can be readily obtained in time for the initiation of remedial measures of this kind.

THOUGHT-READING.

By the Editor.

IN endeavouring to explain those phenomena which come out, after careful elimination of doubtful cases, we must be careful to avoid equally undue confidence and scepticism. For my own part, I am disposed to agree with Professor Barrett in considering that the assumption of *à priori* impossibility is more to be deprecated in the present state of our knowledge of Nature. There is very little fear that science will accept any wild hypothesis in explanation even of phenomena most unlike those which have hitherto been brought within its sphere; for the corrective capacity of science, already strongly developed, increases daily. On the other hand, there is always some degree of danger that questions of interest may unwisely be put on one side as not worth inquiring into, *because* they do not at first seem explicable by known physical laws. The two dangers are, however, closely related together. It is noteworthy that the mind which most recklessly rejects evidence which seems new or strange, is the readiest eventually to accept the most wildly impossible theories. It appears to me that Professor Barrett and his colleagues very fairly present the *à priori* difficulties in this case. Apart from the legitimate grounds of suspicion, open—as they say—to all who have chanced to encounter the alleged phenomena in their vulgarest or most dubious aspects, "it is inevitable that, as the area of the known increases by perpetual additions to its recognised departments, and by perpetual multiplication of their connections, a disinclination should arise to break loose from association, and to admit a quite new department on its own independent evidence. And it cannot be denied that the department of research towards which the foregoing experiments form a slight contribution, presents as little apparent connection with any ascertained facts of mental and of material science. Psychological treatises may be searched in vain for any amount of transmission of mental images otherwise than by purely sensory channels."

Yet the only explanation science can seek is a physical one. It is open, Prof. Barrett considers, to surmise that there is some sort of analogy to the familiar phenomenon of the transmission and reception of vibratory energy.

We are led along this line to conceive that some association may exist between the phenomena of so-called thought-reading, and those strange stories of apparitions at the time of death or of intense suffering, which have been narrated by so many persons of good repute (by so many,

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indeed, well known to fame), as to make the simple rejection of such accounts a very unsatisfactory way of dealing with the evidence.

Respecting these experiences, the editor of the *Nineteenth Century* formulated thirteen years ago in the *Spectator* the following attempt at an explanation :—

"Let it be granted that whensoever any action takes place in the brain, a chemical change of its substance takes place also; or, in other words, an atomic movement occurs. . . . .

"Let it be also granted that there is, diffused throughout all known space, and permeating the interspaces of all bodies—solid, fluid, or gaseous—a universal, impalpable, elastic 'ether,' or material medium of surpassing and inconceivable tenuity. . . . .

"But if these two assumptions be granted, and the present condition of discovery seems to warrant them, should it not follow that no brain action can take place without creating a wave or undulation in the ether? for the movement of any solid particle submerged in any such medium must create a wave.

"If so, we should have as one result of brain action an undulation or wave in the circumambient, all-embracing ether—we should have what I will call Brain-Waves proceeding from every brain when in action.

"Each acting, thinking brain, then, would become a centre of undulations transmitted from it in all directions through space. . . . Why do not such undulations, when meeting with and falling upon duly sensitive substances, as if upon the sensitised paper of the photographer, produce impressions, dim portraits of thoughts, as undulations of light produce portraits of objects?

"The sound-wave passes on through myriads of bodies, and among a million makes but one thing sound or shake to it; a sympathy of structure makes it sensitive, and it alone. A voice or tone may pass unnoticed by ten thousand ears, but strike and vibrate one into a madness of recollection. In the same way the brain-wave of Damon, passing through space, producing no perceptible effect, meets somewhere with the sensitised and sympathetic brain of Pythias, falls upon it, and fills it with a familiar movement. The brain of Pythias is affected as by a tone, a perfume, a colour with which he has been used to associate his friend; he knows not how or why, but Damon comes into his thoughts, and the things concerning him by association live again. If the last brain-waves of life be frequently intensest—convulsive in their energy, as the firefly's dying flash is its brightest, and as oftentimes the "lightening before death" would seem to show—we may, perhaps, seem to see how it is that apparitions at the hour of death are far more numerous and clear than any other ghost stories.

"Such oblique methods of communicating between brain and brain (if such there be) would probably but rarely take effect. The influences would be too minute and subtle to tell upon any brain already preoccupied by action of its own, or on any but brains of extreme, perhaps morbid susceptibility. But if, indeed, there be radiating from living brains any such streams of vibratory movements (as, surely, there must be), these may well have an effect even without speech, and be, perhaps, the *modus operandi* of "the little flash, the mystic hint" of the poet—of that dark and strange sphere of half-experiences which the world has never been without. . . .

"No doubt atomic movements, causing waves in space, must start from other parts of the body as well as from the brain. . . . But the question here is simply limited to how *brains* are affected by the movements of other brains; just as the question of how one pendulum will make other pendulums swing with it is a fair mechanical inquiry by itself, though doubtless other questions would remain as to how the movement of the pendulum would affect all other material bodies, as well as pendulums, in the same room with it."

Of course, the difficulty in this, as in all other attempts at explaining these occasional and extraordinary experiences, is, that there are no known physical laws which would account for the supposed physical action, and that as yet there seems no possibility of any experimental researches on either of the brain-powers supposed to be involved—the power of originating the suggested brain-waves, or the power of receiving them. Then, again, it is difficult to understand why, if the theory be true, the observed instances are so few, compared with the number of occasions on which (considering the 1,500,000,000 persons existing on the globe) we might suppose the suggested powers would be exerted.

If we follow Dr. Muirhead in likening the action of the brain in such cases as these to its action when the organs of sight, hearing, feeling, &c., communicate to it impressions from without, the questions (which Dr. Muirhead reminds me that I asked of him four or five years since) come before us, "What is the organ by which ethereal waves affect the brain? and how are they conceived to act?" This, he says, is asking too much, at least in the present state of psychological physiology. Yet, until these questions are answered, it cannot be said that there is any sound scientific basis for the brain-wave theory.

ENGLISH SEASIDE HEALTH-RESORTS.

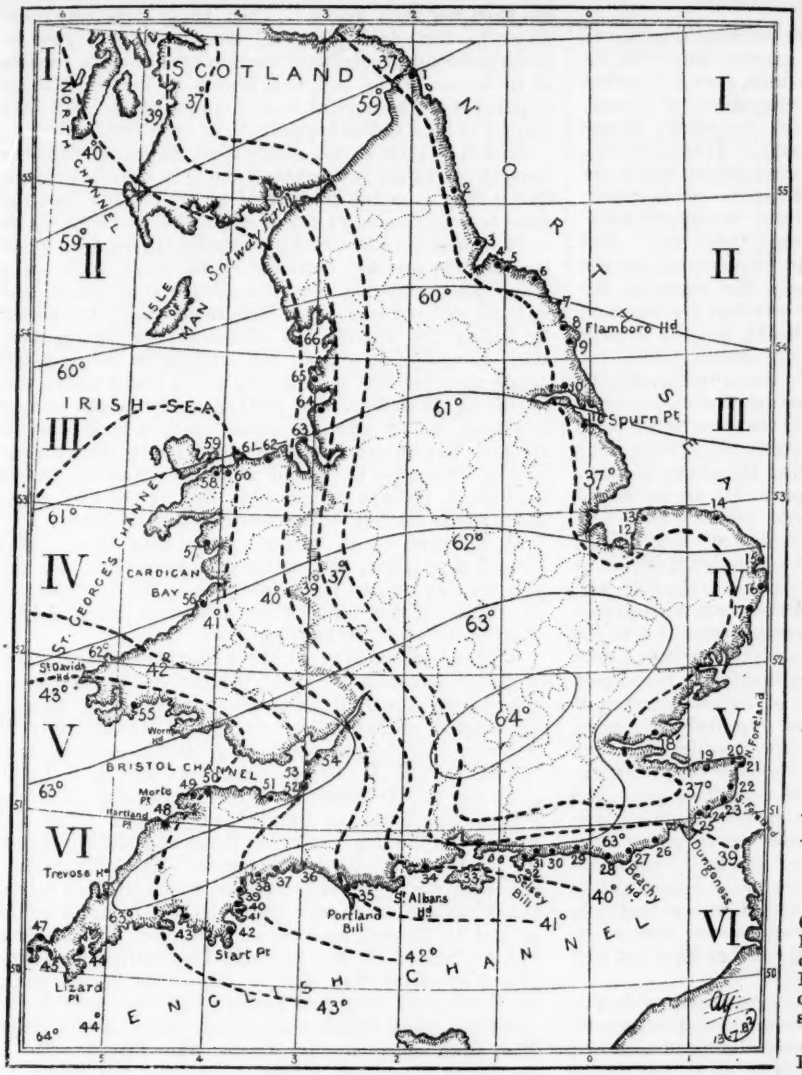
By Alfred Haviland, M.R.C.S., F.R.M.C.S. Lond.

CLASSIFICATION (*Continued from page* 110).

THE accompanying climate chart of England and Wales will, so far as temperature is concerned, enable us to understand the effects of the gulf-stream in winter and the sun-heat in summer, on the climate of our sea-coasts. The mean air temperatures of January and July are given, simply because they are the months in which the extremes of cold and heat are observed.

The *dotted* winter or Gulf stream *isotherms* (heat-contours) must be studied so as to leave a distinct idea on the mind of the mode of their arrangement *around* our coasts. In the first place, it will be seen that they more or less follow the lines of longitude, and therefore cross the parallels of latitude at different angles. Secondly, that they have two sets of curves; *one* having their long axes in the direction of the tidal wave on both sides of England, whilst the others take an opposite direction.

The first set are seen to be deflected from their general north-easterly direction on the west coast, first, by the English Channel, when the degrees 43°, 42°, 41°, 40°, and 39° have their long axes in mid-channel, from off Plymouth to the Straits of Dover, in an E.N.E. direction. Next come the Bristol Channel curves, which give evidence of the important part this broad inlet of the sea plays in tempering the winters of those charming health-resorts with which the north-coast of Devon and the coasts of Somerset and South Wales are studded. These curves belong to the same isotherms as those in the English Channel, but owing to the axis of the Bristol Channel, their direction is as nearly east as possible. The curve in the 37° isotherm shows that the influence of the Bristol Channel extends even as far as the north-east of Gloucestershire. In St. George's Channel the curves deviate less from their normal direction, the



ENGLISH SEASIDE TOWNS AND HEALTH-RESORTS.

1. Berwick-on-Tweed.
2. Tynemouth.
3. Hartlepool.
4. Redcar.
5. Saltburn.
6. Whitby.
7. Scarborough.
8. Filey.
9. Bridlington.
10. Hull.
11. Gt. Grimsby.
12. King's Lynn.
13. Hunstanton.
14. Cromer.
15. Gt. Yarmouth.
16. Lowestoft.
17. Aldborough.
18. Southend.
19. Herne Bay.
20. Margate.
21. Ramsgate.
22. Deal.
23. Dover.
24. Folkestone.
25. Hythe.
26. Hastings.
27. Eastbourne.
28. Seaford.
29. Brighton.
30. Worthing.
31. Littlehampton.
32. Bognor.
33. Isle of Wight.
34. Bournemouth.
35. Weymouth.
36. Lyme Regis.
37. Sidmouth.
38. Exmouth.
39. Dawlish.
40. Teignmouth.
41. Torquay.
42. Dartmouth.
43. Plymouth.
44. Falmouth.
45. Penzance.
46. Sennen.
47. St. Ives.
48. Clovelly.
49. Ilfracombe.
50. Linton.
51. Blue Anchor.
52. Burnham.
53. Weston-super-Mare.
54. Clevedon.
55. Tenby.
56. Aberystwith.
57. Barmouth.
58. Bangor.
59. Beaumaris.
60. Penmaenmawr.
61. Llandudno.
62. Rhyl.
63. New Brighton.
64. Southport.
65. Blackpool.
66. Morecambe.

EXPLANATION.

---------- Dotted lines show the *winter* temperature as influenced by the Gulf Stream.

(Isotherms for January: 37°, 39°, 40°, 41°, 42°, 43°, 44° Fahr.)

———— Fine continuous lines show the *summer* temperature, as influenced by the sun-heat.

(Isotherms for July: 59°, 60°, 61°, 62°, 63°, 64°.) The 44° and 64° Isotherms have been accidently omitted. A line drawn through the Lizard and St. Ives Bay would represent the former, and a curve from 64° to the Land's End would show the place of the latter.

Interlatitudinal Zones:—I., II., III., IV., V., VI.

north-east, and, favoured by the Solway Firth, are seen to cover a large portion of Cumberland.

On the eastern coast 37° isotherm hugs the coastline very closely; still it is seen to be deflected to south-west at the broad mouths of the Tees and the Humber, and to a still greater extent around the Wash and the mouth of the Thames. We need not here repeat the names of the health-resorts which lie between or on these isotherms; they are sufficiently indicated on the map by figures which correspond with the names in the list of seaside towns and health-resorts in England and Wales given above.

Having seen how the Gulf Stream heat tempers the winters of our coasts, we will now proceed to examine the July isotherms, represented by *fine continuous lines*. These lines may be said to cross the January isotherms almost at right angles, and to follow roughly the parallels of latitude. They also are characterised by curves which have a northerly direction as regards their axes. Whilst, however, the winter curves showed that the axis of greatest heat is carried in a North-Easterly direction over the *sea* during January, the summer curves equally well show that the axis of greatest heat extends from South to North over *land*, and that the isothermal curves reach the highest points towards the North along the central axis of the country, whilst on each side of the coast the isotherms are depressed, indicating the cooling effect of the sea on the sun heat of July.

Again, we may contrast the effects of the sea on the air temperature during winter and summer. We have just seen that the Bristol Channel and the Thames *embouchure* allowed the sea warmth to penetrate the surrounding country in the winter; if we now look at the curves in 63° July isotherm around these two sea inlets, we shall at once observe how remarkably the winter heating and summer cooling depends upon the sea.

In our next, we shall group the health-resorts in accordance with the heading at the beginning of our last paper.

FIRE INSURANCE AND THE ELECTRIC LIGHT.—The fire insurance companies of Philadelphia will hereafter, says *Engineering*, cancel policies wherever they find electric illuminating wires attached to the roofs of buildings on which they have outstanding risks.

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OUR NATIONAL GAME.

CRICKET has such a charm for all Englishmen, and such special fascinations for experts, that even its faults are loved—in this sense, at least, that few ardent cricketers can bear to hear of any suggestions of change, even though it be manifest that (on the whole) change would introduce marked improvement. There are also certain points in the game, as at present played, which are deservedly in favour, that would be, to some extent, affected were the changes I am about to suggest introduced. We shall see presently what these are. But be it noticed that the defects to be corrected are not trifling. They affect very seriously the value of the game. It is practically a gross absurdity, for instance, that the finest game we possess should, in quite a large number of cases, result in drawn battles, when yet the progress of the play has decidedly shown the superiority of one side or the other. It is absurd that to the large element of chance already existing in the game itself there should be added *this* further element as affecting the season's fortunes of various clubs, that the games in which they have been inferior may all, or nearly all, be played out, while those in which they would probably have won may all, or nearly all, be drawn: or *vice versâ*. Take, for instance, the Australian eleven—doubtless superior to any county eleven we can just now put into the field, and capable of coping. with fair prospect of success, with elevens representing All England. It cannot be denied that to the really glorious success they have achieved on their merits (a success, however, not surpassing that which has in past years attended the season's work of various counties, as Kent and Sussex in times now regarded as remote, Surrey later, and more recently Gloucestershire) has been added a very conspicuous share due to chance. At the time of writing, the Australians have won fifteen games and only lost one (the game with Cambridge),* while five games have been drawn—but most of the drawn games have been drawn very much in favour of their opponents. Supposing only three out of the five to have been lost by them, it makes a very different record to say that only four games have been lost to seventeen won, than to say that out of sixteen games played out they have lost only one.

We have already touched on the very serious defect in cricket as now played, that a match may not occupy the full time assigned to it. It is very disappointing to all interested in a contest, and should be so to the players themselves, when a three days' match ends in two days; and it is still more annoying when, after two days of play, only three or four (or perhaps only two or three) wickets remain to be taken on the third day.

The element of chance arising from changes in the state of the ground as the game proceeds, or as the weather changes, and again, that arising from the time of day when an eleven goes in, must be regarded as most injuriously affecting the quality of the game,—these do not belong to the "glorious," but to the ignoble "uncertainty of cricket"; and no honest cricketer should have any feeling but disgust when his side wins, because "We went in, Sir, with the ground like a billiard-table"; but when we sent them in, about an hour before the end of play for the day, the ground was a good deal cut up and the light bad, so that we got their six best wickets for less than ten runs apiece." Then heavy rains may come after the first day's play, and those who have gone in under unfortunate conditions may have to resume on wickets all in favour of the ball, and, having to follow on, be all disposed of to the tune of a one-innings defeat. Yet they may be as good as their opponents, or even better.

Cricket is such a fine, manly sport in itself, while the element of chance inseparable from it is already so large, that it should be the interest of all who really love the game *to make encounters as fair as possible, and to eliminate every element of chance which can really be removed without touching the essential character of the game*, while *every game would occupy the full time allotted to the match*, and no *game ever end in a draw*. This could readily be effected by letting the wickets fall alternately on the opposing sides, instead of letting all ten wickets on one side fall before the other side goes in: to which would accrue this additional advantage, that neither eleven would be kept idle long, unless when a wicket gave a good deal of trouble: but an eleven which could not patiently allow nine of its number to look on while the other two made a good stand, perhaps saving what had looked like a lost game, would scarcely be an eleven of true cricketers.

To illustrate by an example, rather than by a lengthy general description, the nature of a game played on this plan, we may suppose the following to be the description of the cricket match between the Australian eleven and the Marylebone Club, as thus played:—

"What promises to be one of the most interesting matches of the season, and a contest tending (as far as can be judged from present appearances) to retrieve the fame of our English cricketers, was commenced Monday, July 10, at Lords. The representatives of Marylebone were Lord Harris, Dr. W. G. Grace, Messrs. Hornby, A. P. Lucas, C. T. and G. B. Studd, A. G. Steel, Tylecote, and Evans, with the professionals Barnes and Flowers. The club having won the toss, put in Dr. Grace and Mr. Hornby, to the bowling of Spofforth and Garrett. At 13 Mr. Hornby gave a chance to the wicket-keeper, which was not taken; but when the score was at 76 he was tempted off his ground by Garrett, and cleverly stumped by Blackham. His innings of 45 was made in his usual brilliant style. The Australians then sent in Massie and Bannerman to the bowling of Steel and Flowers, but when only 5 runs had been made, Massie was smartly taken at the wicket. The Club sent in Mr. Lucas, who played with his customary steadiness, several bump-balls misleading the inexperienced into the delusion that he had been caught out. With the score at 103, Dr. Grace was bowled for 46 by a magnificent ball of Spofforth's. He had played more nearly in his old style than he has yet done this season—in fact, his innings was faultless. The Australians were even more unfortunate with their second wicket than with their first. They sent Murdoch in, but before a run was added Bannerman was easily taken (at mid-off) by Hornby off Flowers. The Club now made a magnificent stand. C. T. Studd was sent in. The score rose steadily to 137, when Lucas let out at a no-ball of Spofforth's, and was caught by Giffen at mid-on, much to the disgust of the bowler. When 142 had been made, Studd was very nearly run out. . . . [Here is supposed to intervene a full and particular account of the play of Studd and Lucas, before the latter lost his wicket.] "When the total had reached 208, Lucas sent Garrett high through the slips, where the ball was held by Bonnor. Lucas had made 45 in his well-known safe style. Studd not out 64. The Australians now sent in McDonnell, who began rather wildly. After a risky square hit (off Steel)

* Commenting on this game, the *Times* (in a leading article), after giving the correct score of the elder Lyttleton in the match with Cambridge, during the first visit of the Australians, said that Mr. Lucas played for Cambridge on that occasion. Our strong impression is that he did not play, being unwell. He was at that time regarded as the best Cambridge bat.

for 2, and a fine square hit (on to the awning of the Grand Stand) for four, the scoring was fairly brisk until McDonnell skied a ball of Steel's to mid-on, where Evans made a clever running catch. The Australians had now made 29, (McDonnell 16), Murdoch not out, 3. The Club, with 199 to the good, sent in Lord Harris; but when 16 had been added, Harris was caught at long-on by Palmer off Garrett. Total, 220; Harris, 4; Studd not out, 76. The Australians, who now sent in Horan, were again unfortunate; for only eleven runs had been added when they lost their captain (for 3 only), caught by C. T. Studd (a fine one-hand catch) off Flowers."

The description would go on, we may suppose, to describe how play was interrupted by rain on Tuesday, the fall of the remaining wickets, alternately, throughout Wednesday, and we can imagine it ending (in accordance with the actual play in the match) somewhat as follows:—

. . . . "The Club sent in Mr. Tylecote, and a few minutes later a single from him brought the 300 on the board, amidst a hearty outburst of applause. But almost immediately after, the Cantab, who had made so grand a stand, was clean bowled by Garrett, having made a faultless innings of 114; total, 300. The Australians sent in Palmer to the bowling of Studd and Barnes. Palmer made a single off Barnes, but was immediately after bowled by him; total, 95. Evans came in next on the Club side, and when, after two more had been made by Tylecote, Evans was easily caught by Palmer off Garrett, there seemed every prospect that the champion would have a part at least of a second innings, but the tenth wicket of the Australians was defended with unexpected obstinacy. Spofforth (the newcomer) and Giffen made runs with considerable freedom, and at ten minutes before 7 the board showed 120. At 122 Steel replaced Barnes, and Spofforth cut him for two. Flowers took the ball at the other end, but "the demon" drove him twice to the boundary in successive overs. Steel tried his hand at the pavilion end at 137, but it was not until the final over before time was up, and with the last ball but one of that over, that Grace clean-bowled Spofforth. The match thus ended after the fall of ten wickets on each side, the Club winning by 164 runs."

It will be understood, of course, that a match would be completed with the fall of the last wicket taken before time was up, if that gave both sides an equal number of wickets —otherwise with the last but one, *unless* after the last but one had in this case been taken, the other side without losing a wicket carried their score beyond that made by their opponents, when of course they would be adjudged winners by so many runs and a wicket. Otherwise, every match would be won by so many runs, never by wickets. There would be no "following on" under any circumstances.

It seems not unlikely that if an arrangement such as this were adopted—by which every match would be decided, yet every match would occupy the full time allotted to it—three days' matches would, for the most part, be replaced by two days' matches, more games being arranged during each season.

We are quite aware that in the working out of this scheme several minor matters would arise to which exception would be taken; but they would not be comparable for a moment with the very serious defects which this system of the alternate fall of wickets would obviate. Let it suffice to note that, according to present arrangements, the odds are greatly against a match satisfactorily filling up the time allotted to it and yet being completed within that time, while in the great majority of games the toss, or weather chances independent of the toss, largely affect the result. With such defects it must be confessed that cricket as at present played has some most unsatisfactory features. As modified, it would deserve to be regarded as the finest outdoor game of combined skill and chance in existence.

A TERRIFIC COMBAT.

THE following account of a fight between a snake and a rat is extracted from a Californian paper, the *Stockton Mail*, near which city the encounter is said to have been witnessed; and has a rather less impossible air about it than most newspaper yarns in which the "Ophidia" play a part. I transcribe it *verbatim*, in the hope that it may prove of passing interest to your readers, not in illustration of any principle:—

"The snake was of unusual size, and of a different appearance from those commonly found in water. The rat was of the ordinary brown variety, and was running along the shore when the fight began. The snake was coiled upon a little point of mud just above the water, sunning itself, and probably asleep. The rat, apparently without noticing the snake, jumped directly upon the folds of the serpent's body.

"The snake struck instantly, fastening its fangs between the rat's shoulders. Then began a contest that, in its small way, was truly thrilling. The rat, struggling violently, endeavoured to shake itself free, while the snake as persistently endeavoured to drag the head of its victim into its own mouth.

"This feat it was at first unable to accomplish. The rat writhed in its convulsive efforts to escape, bit the big snake severely in the neck, just at the back of the head, until the blood flowed and mixed with its own.

"These counter-attacks became at last so savagely painful, that the snake loosened its grip, remaining, however, in half-coil. But the respite was too brief to afford the rat an opportunity to escape, for again the snake's fierce jaws descended and closed, this time around the rat's head.

"The heavy body of the rat swayed violently, but dragged with it the head of the snake, until the latter was completely out of coil. By this time, however, the rat's struggle had become comparatively faint, and the snake was apparently the victor.

"But the next moment the snake in its turn began to struggle violently, as if to release its adversary's head, but ineffectually, and the reason was soon apparent.

"The rat had bitten quite through the snake's throat, and its sharp teeth could be distinctly seen in the narrow slit they made.

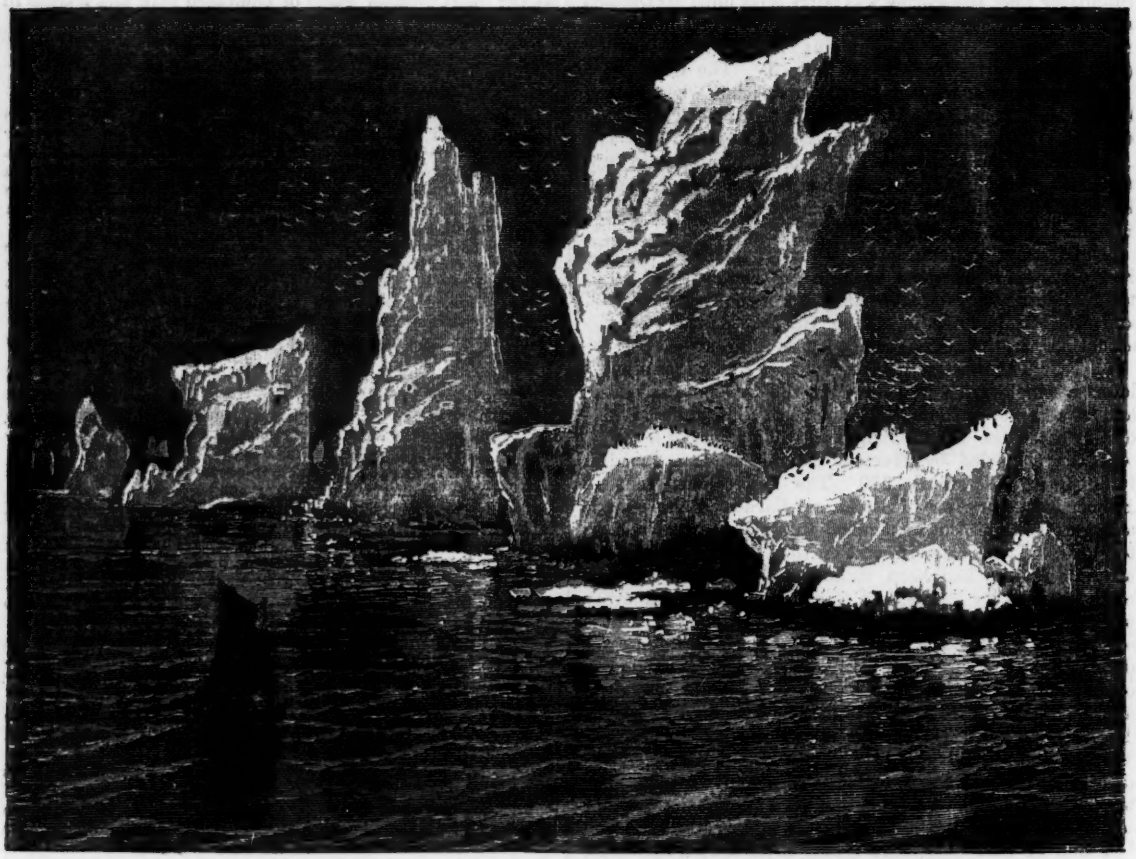
"The writhings of the snake were now intense. It lashed the ground with its tail, and raised its thick folds to almost half its length from the ground.

"The spectator stood hesitating, scarcely knowing whether he ought or not to interfere. The next moment, the snake, with one last convulsive effort, threw half its length into the muddy water, and the doughty twain sank together to a common death."

This snake, if the narrative be really a true one, must have been some non-venomous colubrine—probably some species of genus Coluber, or possibly a large variety of Heterodon or Ablabes; a non-constrictor, too, otherwise it would have crushed the rat to death before attempting to commence the swallowing process (its "remaining in half-coil" is rather vague, and does not count for much in any case). Most likely it was naturally a frog and fish-eater, like most colubrine snakes, but was exceptionally ravenous after desquamation. "Fangs" is, of course, a figurative expression; clear enough in its import when applied to a wolf or dog, but rather apt to be misleading when used in respect of a serpent. Teeth are evidently meant, since it is obvious that the reptile could not have been a poisonous one. There are much fewer extravagancies and palpable inaccuracies in this anecdote than are commonly met with in such. The declaration that it only "raised almost half its length from the ground" commends itself to our admiration; most snakes in so strongly dramatic a situation would have been seen to leap bodily into the air. The brusque behaviour of the rat precludes any pretence of "fascination," also; while "probably asleep" is remarkably ingenious, and may be held up for the consideration of certain writers who assume a much greater familiarity with matters ophiological than the modest spectator of the above-quoted incident lays claim too, and who too often assert that such and such a snake "was asleep at the time," or something to that effect. How on earth can they say when a snake is asleep? It can't shut its eyes, and mere quiescence is most certainly not enough to indicate it, since the reptile will often spring upon its prey from a position of repose which it may have occupied for a long while previously, without any warning or indication by movement.

Snakes do occasionally catch a tartar. There is a preparation in the Museum of the College of Surgeons, showing the stomach of one, the coats of which have been ruptured, and the superjacent

XUM



A PROCESSION OF ICEBERGS.

skin perforated by the claws of a little lizard, which had retained sufficient vitality to exercise them in that situation.—I am, Sir, your obedient servant, ARTHUR STRADLING, C.M.Z.S.
29, Woodford-road, Watford, Herts.

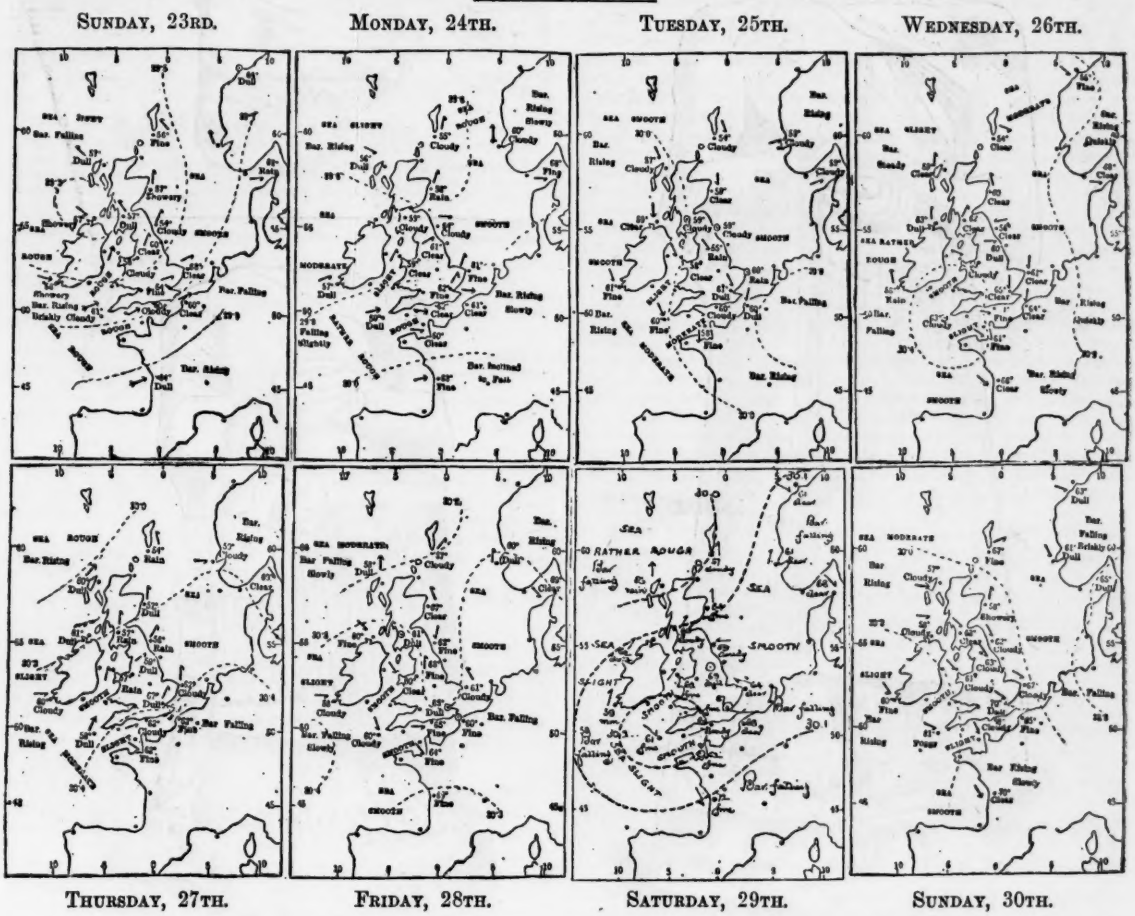
A PROCESSION OF ICEBERGS.

WHILE a procession of icebergs in New York Harbour would be a genuine novelty sure to attract general attention, the spectacle is so often witnessed in Placentia Bay, off the south coast of Newfoundland, as to possess little interest to spectators. This bay is a deep inlet, seventy-five miles in length, and nearly sixty in breadth at its entrance. The icy monsters from the North float in with the tide in spectral procession, and then drift out again in irregular groups, often colliding and going to pieces, and always a strangely-picturesque effect to the bay. The illustration faithfully depicts the scene as it presented itself to the artist on a summer visit.—*Frank Leslie's Illustrated.*

EXCAVATIONS AT EPHESUS.

AT a meeting recently held at the Mansion-house, to promote the resumption of the excavations at Ephesus, on the site of the Temple of Diana, the Lord Mayor, who presided, said the famous Temple of Diana, at Ephesus, one of the seven wonders of the ancient world, had been hidden from view for many centuries, and its exact site was unknown, when in 1869, Mr. J. T. Wood, after six years of search, found its remains more than 20 feet below the present level. The trustees of the British Museum, who had supplied the means to explore some of the public buildings at Ephesus, then authorised the exploration of the ruins of the temple, and five years were devoted to the work, with the aid of Government grants to the amount of £12,000. In 1874 very important excavations at Babylon and Nineveh were being carried on by the English Government, and the trustees resolved to suspend the work at Ephesus, as they thought it inexpedient at the time to apply to Government for fresh grants for the purpose. Mr. Wood had from year to year applied for a grant to continue and complete the explorations at the temple, but the times had been unfortunate for such enterprises, and there was little or no chance of further Government aid. An influential committee, under the patronage of the Duke of Albany and the presidency of Mr. Beresford-Hope, M.P., had been formed to resume the explorations by the aid of a public subscription, and it was in support of that object that that meeting was convened. Professor Hayter-Lewis read letters expressing sympathy with the movement from the Prince of Wales, the Dukes of Connaught and Albany, the Primate, Cardinal Manning, Lord Shaftesbury, Canon Farrar, and others, including Sir F. Leighton, the President of the Royal Academy, who wrote that few discoveries had been of greater interest to the world of art and archæology than those at Ephesus, and it would be a grievous thing if this country, possessing, as it did, the site of the Temple of Diana, should not continue the excavations, which had already produced so valuable a harvest. Mr. Beresford-Hope, M.P., said Mr. Wood was only on the threshold of his discoveries, and the very idea of a further grant from Government to continue the excavations was beyond hope. Mr. Newton, C.B., moved that the complete excavation of the Temple of Diana at Ephesus was an object well worthy of support from the nation, which now possessed in the British Museum the only portions of the beautiful sculpture as yet discovered at the temple, and that a subscription list be at once opened for the purpose. Professor Donaldson seconded the resolution, which was adopted unanimously.

WEATHER CHARTS FOR WEEK ENDING SUNDAY, JULY 30.



In the above charts the dotted lines are "isobars," or lines of equal barometrical pressure, the values which they indicate being given in figures at the end, thus—30·4. The shade temperature is given in figures for several places on the coast, and the weather is recorded in words. The arrows fly with the wind, the force of which is shown by the number of barbs and feathers, thus:— ⟶, light; ⟶, fresh or strong; ⟶, a gale; ⟶, a violent gale; ⊙ signifies calm. The state of the sea is noted in capital letters. The * denotes the various stations. The hour for which each chart is drawn is 6 p.m.

CHALDEAN ANTIQUITIES AT THE LOUVRE.

ALTHOUGH it will be necessary to await the publication of M. de Sarzec's promised work on his explorations, before it is possible to finally assign to his Chaldean relics their true position in the history of culture, yet there are a few considerations regarding this primitive civilisation, concerning more particularly the peculiar style pourtrayed in the objects themselves, which will be of interest. This is especially the case because of the recent acquisition by the British Museum of a fine collection of antiquities from the same site.

Before proceeding to discuss these, it is worthy of notice that we can glean enough from M. de Sarzec's letter to the French Academy to make it certain that the architectural arrangement of the edifices were direct precursors of those already made known by Layard, Botta, and Rassam, as essential features of the temples and palaces of Assyria. For, like these, the buildings lately unearthed have the angles carefully oriented to the cardinal points of the compass, and are constructed of dried bricks, erected upon a massive foundation courses made of crude bricks cemented with bitumen. In at least one case, also, a Ziggurat, or building with retreating stages, has been found.

The most striking objects of the collection are the numerous statues, especially a group of them found crowded together beneath the soil in the large edifice occupying the principal mound at Tello. Besides being connected by this strange proximity of position, they are united by the fact that they one and all bear the name and titles of Gudea "patesi" of Zirgulla. This collection of statues, and indeed all those found at Tello, have one stereotyped attidude, viz., the arms crossed upon the breast, the right hand held in the left. This posture is similar to that which in Assyrian bas-reliefs (and indeed among Orientals at the present day) is indicative of the respect of an inferior to his chief, and, although it is possible its universality in the Tello figures may be because it was the conventional attitude considered proper for a statue, yet it seems more natural to seek for some other explanation. M. Heuzey, in his memoir on the subject, suggests one which certainly seems reasonable, and also enables us to understand why the largest statue of all, which, according to M. Oppert's rendering of its cuneiform inscription, is certainly that of Gudea, should be no exception to the rule.* His

* The following is M. Oppert's translation:—Dans le temple d'Hercule est érigeé cette statue de Gudea "patesi" de Sirtella qui a construit le temple de Moulkit (Bel.). Il a promis de donner journellement, aussi longtemps qu'il sera gouverneur, un bath de lait, un epha de foin, et un epha de pain consacré pour detourner la malédiction devin. Il obeira à l'injunction d'Hercule; puisse-t-il, pour remplir sa promesse, exécuter son intention dans le temple d'Hercule, et que sa prière devienne vérité.

XUM

ANCIENT CHALDEAN STATUES.

theory is that all these statues were, in a certain sense, votive, that is to say, they were placed in a temple or sacred place either before the image of one of the deities, or of the symbols of their divinity. Hence the attitude of humility was the sculptor's mode of expressing his religious fervour, and this view is somewhat supported when we recollect how frequently this is the position assumed by many of the figures exhibited by the Assyrian statuettes.

One distinctive quality of the Chaldean statues is the peculiar character of the proportions adopted by the sculptors, showing that, at least in this respect, they had not attained to the perfect canons prevalent at this period in Egyptian art. This is the excessive robustness and short, or squat appearance of the figures. If, however, the execution is imperfect in this respect compared with that of other races, it surpasses them in the successful carving of the nude parts of the body and the manner in which the folds of the raiment are indicated, in these respects heralding more nearly the glories of the Greek masters than any other known prehistoric art. The only clothing shown on the larger statues is the large fringed shawl so often to be seen in Assyrian costume, but in these earlier objects the fringe is only expressed by a parallel line to show its width, instead of being ornamented as in the elaborate late Assyrian work. In all cases the shawl is shown folded across the body in a similar style, so arranged as to leave the right arm and shoulder uncovered. Some of the small bronze statuettes represent persons clothed with a short skirt, and in the bas-relief containing the battlefield scene, with the dead lying on the ground; there are figures clad in this manner carrying baskets on their heads which they support with both hands, and, strange to say, this is exactly the attitude of the statuettes found by M. de Sarzec, and also of some which have been discovered by previous explorers.

In conclusion, it may be pointed out that, excepting apparently wilful injuries, these antiquities are in admirable preservation, and therefore we may be assured that whenever further researches are made in the Mesopotamian delta, they will be amply rewarded. Scarcely a week passes but some valuable acquisition to knowledge is gathered from cuneiform inscriptions, such, for instance, as Prof. Sayce's discovery of a counterpart of one of the well-nigh unknown ancient Indian alphabets. In the British Museum are thousands of inedited tablets, which are being multiplied at a much greater pace than they can be decyphered and published, and it is now evident that we possess in these, and the far richer treasures still buried beneath the soil, more priceless records of the progress of the human race than the most ardent archæologist would have dared to hope for even but ten years ago.

A Member of the Society of Biblical Archæology.

Accident from Lightning.—A telegram from New York, a few days since, stated that a large brick building in Texarkana, Arkansas State, had been struck by lightning, and subsequently fell on an adjoining wooden building, used as a liquor saloon, completely crushing it. The saloon caught fire, and several people who were in it at the time were killed.

[Accidents of this kind are of great importance, and we should take it as a favour if any of our readers on hearing the particulars of disasters caused by lightning would kindly send us the information.—Ed.]

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE: *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

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**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

A VERY COMMON MIND TROUBLE.

[497]—I frequently *when unwell* have a species of this trouble, viz., a sudden thought to do or not to do an act. I rarely pay any attention to it, putting it down to biliousness. The strange part is I repent not paying attention to it, as, had I done so, some loss or unpleasantness would have been averted. [Always, or in certain cases, which alone are noticed?—ED.]

JOHN ALEX. OLLARD, F.R.M.S.

TEA AND COFFEE, HOT AND COLD DRINKS.

[498]—A "cold water drinker" would be glad if any of the numerous readers of KNOWLEDGE could inform him whether the drinking of tea, coffee, cocoa, &c., is preferable to that of water in its natural state, for the physiological and psychological development of man, and whether hot beverages are beneficial in cold weather?

By inserting the above you will greatly oblige,

J. WILLIAMS, JUN.

ARE TOADS POISONOUS?

[499]—I have a large St. Bernard dog which has just been poisoned. He was out with my servant, and she states it picked up a large toad, and carried it for a few yards in its mouth, when it suddenly howled and dropped the toad. It commenced to foam at the mouth, and vomit, and was very relaxed. Do you think this action can be attributed to the toad? Thanking you in anticipation,

HERBERT BROWN.

CALEDONIA.

[500]—Mr. Charles Stewart says in your issue of June 16, that "Caledonia" and "Gaidhile dhonna" are almost identical; the meaning being "*brown-haired Gaels.*" I have always understood that the word "Caledonia" was derived from "Cavill davin," that is, "People of the woods," but as I am always open to correction, I should be glad to know the true derivation of the word "Caledonia."

W. H. PLAISHER.

THOUGHT READING AND WILLING.

[501]—In your papers on "Thought Reading," &c., I should be glad if you would insert a word of caution to inexperienced persons as to the danger of such experiments as "Willing." I have seen a good deal of such trials, and think that with some constitutions they are actually prejudicial. On two occasions I have known the persons "willed" to be put actually asleep in a sort of mesmeric trance, the sleep on one occasion lasting a considerable time, and, from what I know of mesmerism by my own experience, I have no doubt that, had any force been used to arouse them, disastrous results would have followed. I have frequently known persons of nervous organization to be, to use an expressive term, "knocked up" for the rest of the day by being "willed," especially after having been (as is quite possible) forced to do a certain act against their own will. I consider that anyone meddling with these subjects without experience runs a considerable risk, and is decidedly playing with edged tools.

T. PRESTON BATTERSBY, F.R.A.S.

THE ARTISTIC PERCEPTION OF ANIMALS.

[502]—With reference to the subject of letter 472, p. 118, I once had a cat which I could throw into a paroxysm of fear by slowly gliding a gaudily painted model of a Burmese boat, cut in the form of a dragon, towards her. She did not run away from it, but seemed to be fascinated—always retiring in sidelong fashion, with arched back, and much "fuffing" and "spitting." Notwithstanding repeated introductions, she never grew reconciled to the monster, and to the end of her days regarded it with horror. I think this rather strange, as the figure was utterly unlike anything in nature, and so could not, one would think, have suggested anything at all to tabby's mind. I should have expected her merely to smell it.

I have heard it stated that a cat only looks at itself in a mirror once in its life—that once being the first time it is given the opportunity. Is this so?

J. A. WESTWOOD OLIVER.

CHANGE OF COLOUR IN BLOWPIPE BEADS.

[503]—The remarks of Aug. W. Orr on p. 118, letter 473, headed as above, may possibly mislead some of the readers of KNOWLEDGE. A bead before the blowpipe flame is certainly a source of light, just as a red-hot poker in the fire is; but after the bead is taken from the flame and has cooled to an extent that it is no longer a source of light, this same bead *has colour*, and it *may change* its colour. Plainly, then, the light rays from such a coloured or colour-changing bead which reach our eyes are borrowed; in other words, we are only enabled to see the bead by means of its reflected light.

WM. ACKROYD.

A QUERY.

[504]—Will "Pangul" (page 145, Dec. 16) allow me to write to him for information about 2nd B.Sc. London? I am obliged to depend on my own reading for the exam., and should be very grateful for any information.

J. H. WARD.

Oakley-house, Caversham-hill, near Reading.

VARICOSE VEINS AND CYCLING.

[505]—To "A Tricyclist," Without being a medical man, I may perhaps be allowed to express the opinion that varicose veins are not induced by cycling.

The action is smooth and easy (without any jars or concussions, as in walking, running, or jumping), and thus favourable to soundness even in those who have a tendency to enlarged veins.

In my own case, I seriously injured my knee at football, and long before I could walk, even a few miles, without swelling and pain, I could ride any distance at any pace without subsequent inconvenience.

Of course, a novice may over-strain himself and cause injury, in tricycling, but varicose veins, and even hernia, have, I believe, been caused by running down stairs. I know several cyclists, sorely troubled in this way (not brought on by riding) who ride in elastic stockings with comfort and pleasure, some even being prominent on the racing path.

LACY HILLIER.

FAIRY RINGS.

[506]—The circles of rank grass referred to by Mr. W. Mattieu Williams were not Fairy Rings. No one who had ever seen true Fairy Rings could have mistaken such circles of rank grass for them. Fairy Rings are very frequent on steep grassy hill sides, they are common on the South Downs, and on steep places like the Devil's Dyke, near Brighton, and on the sides of the Chiltern Hills in Beds and Herts. Who ever saw grass-cocks on such places? Fairy Rings are often only a yard in diameter, but sometimes fifty yards or more across. Has anyone ever seen such small or such large grass-cocks? Fairy Rings are often semicircular, at other times ogee-curved; I have never seen grass-cocks of these patterns. The rank grass round where grass-cocks have stood is known to everyone.

Fairy rings are caused by the growth of the fungus commonly known as the "Fairy Ring Champignon" (*Marasmius Oreades*). The rank circle of grass is caused by the decay of the previous year's agarics, and every one who has paid any attention to the subject well knows that the same circles increase in size year by year. Another fungus, named *Agaricus geotropus*, causes Fairy Rings of gigantic dimensions in grassy places, and many other fungi, large and small, cause abnormal circular growths as the circle of wharts common on decaying apples and pears, and the circles on the head caused by the ring-worm fungus.

W. G. SMITH.

[Letters to same effect received from E. A. H., J. Pennington, and others.]

XUM

Answers to Correspondents.

**** *All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—*1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded, nor can the names or addresses of correspondents be given in answer to private inquiries. 3. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 4. Each letter should have a title, and in replying to a letter, reference should be made to its number, the page on which it appears, and its title.*

H. J. MADGE. You cannot get over the difficulty that way. The photograph shows the comet just as it would have been seen. Now wherever the comet was, a straight line from the sun to the comet's head, produced so as to give the usual direction of the tail, would be seen as a straight line. In other words, if the direction of the comet's tail had been exactly from the sun, the tail would have seemed to extend directly from the sun. Set a globe somewhere to represent the sun; at any distance from it fix a straight rod aimed (so to speak) directly at the globe's centre. Now see if you can find any spot from which when you look at the rod it will not seem directed apparently straight towards the globe's centre. Or get a photograph showing it otherwise (if you can).—E. M. KING. Very glad to be of use.—S. BARBER. Will, if possible, insert the article in whole or in part; but if not, pray consider that our poverty (of space), not our will, forbids.—HALLYARDS. (1.) Am not acquainted with the rules of Loo. If anything was gained by the frequent turning of nine of diamonds, should think the person who turned it open to suspicion. (2.) The laws of probability cannot be applied to the case of selection of names for novel. Odd coincidents must arise where there are a great number of events; and we note such coincidences when they occur, as you noted the publication of a novel named "Ralf Skirlaugh" when you had yourself written one to be called "Ralph Skirlaw." Captain Marryatt came near having to fight a duel on account of his novel "Masterman Ready," because a Mr. Masterman Ready, quite erroneously, supposed the book was named after him. (3.) I was much pained to learn that any answer of mine had hurt you so much that it seemed as if life were no longer worth living, and turned over the back numbers to find the answer you referred to, with the painful consciousness that—if so—"my 'banter' must," indeed, have been "tickling with a red-hot poker." I was rather relieved to find—p. 482, col. 2—that my fearful sledge-hammering, vitriol-throwing, soul-crushing rejoinder, had been simply worded thus: "Will you excuse me if I hint that you have evidently much more leisure than I have; if one correspondent in twenty wrote at such length, what could a poor editor do?" Surely that ought not to have produced so painful an effect. I do not see where the red-hot poker comes in. Properly to reply to and comment upon a letter which ran to four quarto pages, closely written, required more time than I could spare, and I said so, politely enough as I thought. Do you not see that the more clearly I indicated my inability to answer you as I could have wished, the more fully I showed what my wish was? I hope others who think me vitriolic, sledge-hammery, and red-hot-pokery, have no juster reason for complaint.—A FIFTY-FIVE YEARS' OLD NATIVE OF NEW ZEALAND. "In what direction is the resultant force generated by the various motions of the earth expended?" The various motions of the earth, resulting from the various forces to which the earth has been subjected, cannot be said to generate force. You might with reason ask how the various motions of the earth have been generated, for though astronomy can show how several of them are produced, it has not yet accounted in measure and quantity for all; and its explanation of the various motions of revolution, reeling, the perturbations of each form of motion, and so forth, are a very difficult subject of study. But there is no reality in the problem you submit. You write from so great a distance, and have to wait so long for an answer, that I should be really glad to try to answer your question satisfactorily; but I cannot understand it. You say, "No book on astronomy which I have ever read has touched upon this point;" and this rather relieves my mind, as showing that you have got hold of a rather out-of-the way difficulty (or that such a difficulty has got hold of you?). Then, immediately after, you say, "This theory is not my own, and if I am afraid to mention its author, it is because I remember the effects of the thought of him on poor De Morgan about nineteen years ago; it unnerved him so that he actually forgot in discussing his subject to furnish a little of that plain and sensible argument which on other matters he displayed so well." This, again, relieves me; for I am sure you are mistaken about De Morgan being unnerved; whenever he did not furnish plain and sensible argument, it was because he knew it would be perfectly useless. On the other points in your letter, you must have misunderstood me greatly, if you gather from what I say in my article on the Pyramid, in No. 17, that practical astronomy has determined the distance of Alpha Draconis (Alpha Centauri is referred to) as accurately as that of the sun; how any one can read what I there say by way of connecting the Great Pyramid and the great fifteen puzzle with the distance of Alpha Centauri, and not see that I was jesting, I fail to comprehend. Certainly the capacity some persons display in taking banter for earnest surpasses comprehension. I once wrote an article in which, in humble imitation of nature-myth theories, I advanced the hypothesis, that Tom Tom, the Piper's Son, was Thammuz, son of Kineros, the Piping one (or the Wind), and that in the misery of the unfortunate nursery Thomas, the same nature-changes were symbolised as in the old legends of the death of Thammuz. I explained also that little Jack Horner, eating a Christmas pie, was the weak winter sun, horned as with rays, at work on the clouds of the winter sky (Christmas being near the time of the winter solstice), and so forth. Reviewers gravely discussed this banter, some finding "strong arguments," others "insufficient evidence," in my article—only some one in ten recognising the real object of the paper, which was to discredit the exaggerated faith in nature-myths as interpreting almost everything traditional, from nursery tales to the Hebrew records. Since then I have felt that nothing not absolutely labelled "a goak" will be understood as such. (If I did not know for certain that I am English born—even a Cockney, if Chelsea means Cockneydom—I should imagine I must somehow be an American, for among Americans quiet jokes are understood all round, and flavour ordinary intercourse very pleasantly; no one has occasion to explain "This is 'only pretend,'" as children say.) Still I *did* think I might be suspected of joking when I found the Boss Puzzle in the Great Pyramid. Or, must students of science *never* smile? If so, I would rather give up science; but fortunately it is not so.—$\left(\frac{\pi}{2}\right)^t$. (Permit me to remark in passing that unless "pie" be of moderate dimensions, dividing it by two only before raising it to the *t*th, is unwise). The question whether the nineteenth century began on January 1, 1880, or on January 1, 1801, is equivalent to asking whether eighteen centuries amount to 1799 years or 1800 years. On January 1, 1880, only 1799 years had elapsed from the beginning of the Christian era; and, according to Cocker, it requires 1800 years to complete eighteen times a hundred years.—W. A. BENNETT. The "woman haloed" and the "goddess crescent-horned" are one and the same, and much more ancient than the lady you mention.—UNBELIEVING THOMAS. I rather think myself that Mr. W. M. Williams's theory of fairy rings must go by the board. It accounts for some rings (and Shakespeare's may have been of that kind), but certainly not for all.—HEADS thinks there *is* a science of phrenology.—A. S. No medical man could advise without seeing you. Consult your family doctor, if you have one; if not, one who has good practice as a family doctor. As to general regimen—take much outdoor exercise, shorten hours of sleep as much as possible, and sleep on a mattress. "When you turn, turn out." Avoid all stimulants. Seek society which will rouse emulation, whether in sports or in studies. Read wholesome manly works of fiction, (not namby-pamby sentimentalisms), travels, history, and so forth.—THOS. ADAMS, JUN. No suitable portrait of the editor exists. Either he is too modest, or he thinks (as Emerson used to say—only pray remember Emerson was an American, and would gravely say what he did not wish to be taken quite in earnest) "that no portrait yet taken presents all the charms of the original."—R. S. MCKERRELL. See review of books on "Dress," in this or early number, as to question of belt *versus* braces.—F. J. NANCE. That explanation of a top spinning is scarcely sufficient; it describes what actually happens, but hardly shows why it should happen.—FRED. HARPER. "Draughts" is even more scientific than chess; but so few take interest in it.—H. A. BULLEY. Many thanks; but your article goes over ground already sufficiently treated or to be treated.—W. B. KESTEVEN. Dr. Carpenter cites similar instances in his "Mental Physiology." Such cases show how much certain powers of observation may be strengthened or extended by practice.—D. H. The word Khedive should properly be pronounced Kaydeevay; but it is generally pronounced Khĕdīve, and custom authorises this pronunciation. Both pronunciations of "pasha" are given, but most authorities place the accent on the second syllable. About Evora I do not know.

ERRATA.—The footnote to our article on "Lower Life Forms"—in review of Dr. W. K. Brooks' excellent work, "A Handbook of Invertebrate Zoology"—unfortunately passed wholly uncorrected. The verbal corrections are obvious. The book, of course, is for *Laboratory and Seaside work*, and is published by Messrs. Trübner & Co., London. We take the opportunity to add that the book contains 200 illustrations. Its price is 15s.

XUM

Our Paradox Column.

A Correspondent thinks an occasional Paradox Column might afford instruction as well as amusement. I think so too. But just now I think more of the evidence such a column might afford, that, in not admitting certain letters and theories into Knowledge, I have been guided by the honest belief that they are not strictly scientific. Now here is a letter which, oddly enough, was opened next after the one asking for paradoxes. What can one do with such communications?

The P.D. Theory.

Editor, I flatter myself that the P.D. Theory has a good hold, but, mistakes are so easily made; If the Theory of the P.D. Sir has any weight in it, let it go ahead, I am sure it will find its road through all other theorys, as it is composed from a natural idea, taken nature to have only one course, path or way, nature cannot go the wrong road without a change takes place, which it cannot change its-self as there is only the one way, and that way is its-self, it has the whole within its-self, nothing can change without been mixed, nature is pure, if it were to change by been mixed, it would not be pure, nor would it be natural—nor would there be any nature; Then what would we have, (Nothing) oh no, time says there has always being something or else the light of our sun could never be ever-lasting and pure; Which denotes all things in one class to be of one class or quality; shown that all planets are of one class, and all stars are of one class, also all of one class must move round one way, there is no other way in nature; the same with comets and meteor's, every thing in nature is self-acting, the sun-beams upon our earth until it rises a vapour and spreads it like a sheet which acts as a safety-valve or else our green carpet would soon be dismantled, we would not have any light if the sun did not rise the vapour every day, as light cannot light without something to light upon, nor can we have heat without the light, or else every thing would be cold, dark and lifeless.

Sir,—I cannot see in any way the P.D. Theory has taken harm by the new photo of A. C. Ranyard comet shown in Kno.—July 14—1882 As we have only the one front view of comet, the tail might have a very short or quick radius, but according to radius so will the distance be from the centre, as gravitation has its radius or law worked from the centre; judging from its tail, it must be a full grown comet, such as seen in gone by times when they looked beautiful, old comets that appeared in olden times looked like a sun without any tail.

Sir,—I would like to see Mr. R. A. Proctor, Try this system (on) one twelve months. Or give me the address of one a American astronomer, a go ahead party. J. Murray.

Science and Art Gossip.

Professor Loomis states that the heaviest rainfall is met with in the rain-belt which surrounds nearly the whole globe lying between the north-east and the south-east trade winds. Mr. W. J. Black, having been engaged in collecting records of rainfall at sea for some time back, gives an estimate of the rates per annum for this rain-belt. That for the Atlantic Ocean is calculated at 133·37 in. per annum, that for the Indian Ocean at 80·55 in. per annum, that for the Austral-Chinese seas at 107·96 in.; but none has yet been made out for the Pacific Ocean, owing to absence of observation altogether from that quarter.

Mining Statistics.—The Mines Inspector for North Staffordshire, Cheshire, and Shropshire, Mr. Thomas Wynne, reports that the number of persons employed in the various mines under his jurisdiction during last year was 24,499 against 22,852 in 1880; the quantity of minerals raised was 8,644,382 tons against 7,576,400 tons; the number of persons employed to each fatal accident was 583 against 476; the number to each life lost was 318 against 206; the tons of mineral raised for each fatal accident were 205,818 against 157,842; tons to each life lost, 112,261 against 68,265. The number of mines was 240 against 245, and the non-fatal accidents were 343 against 321.

Tree Burial in New Zealand.—The recent fall of an enormous puketea tree near Opotiki, New Zealand, disclosed the fact that the hollow interior from the roots to the first fork, about forty-five feet from the ground, had been filled with human bodies. A confused heap of skeletons burst out of the butt of the tree when it fell. A local paper says:—"A more extraordinary sight than this monarch of the forest lying prone and discharging a perfect hecatomb of human skeletons can scarcely be conceived. Some are nearly perfect, while others are mixed up in a chaotic mass of heads, hands, feet, and arms, indiscriminately. All the Maoris here seem to have been quite unaware of this natural charnel house, and declare that it must have been filled long before their or their fathers' time. Indeed, the appearance of the tree fully justified the supposition that it must have been some hundreds of years since this novel family vault was filled with its ghastly occupants."

Mr. Boucicault on Acting.—On the stage of the Lyceum Theatre, on Wednesday (20th inst.), Mr. Boucicault delivered to a large audience of actors and others interested in the drama a lecture on the "Art of Acting: Its Rules and Principles." The lecturer's object was to show that acting might usefully be taught like painting and other arts. With this view he dealt with his subject under the several heads of articulation, gesture, posture, and study of character, each of which he illustrated from his own experience of the stage. As regarded gesture and posture, in particular, he showed that the true principles of the art existed merely as a tradition, and had to be picked up by the conscientious actor as best he could. It was not enough to behave on the stage as one would do in real life, as the lecturer proved by the simple act of picking up his hat from the table to walk out. The actor had to remember that his every action was presented as in the frame of a picture, and that it had to be studied with reference to the effect it would produce upon the house. The art of listening, and of continuing to sustain a character, even when he had nothing to say, was therefore an important part of the actor's art, though a part, unfortunately, much neglected. Under the head of posture, the lecturer insisted upon the necessity of cultivating the "lost art of walking"—an art now possessed only by uncivilised people, whose ankles had free play, and who were in the habit of carrying weights upon their heads. The study of character, he showed, ought to be "from within" and not "from without." In other words, the character ought to be drawn from the nude, and the costume fitted to it afterwards. It was also desirable, whenever possible, to study a character from life, as Charles Mathews and Farren did for their parts of Dazzle and Sir Harcourt Courtly in "London Assurance." On all the points the lecturer contended that a course of instruction, such as was followed at the Conservatoire, would be beneficial to those who desired to adopt the stage as a profession. The lecture, interspersed as it was with much genial anecdote and practical illustration, was both entertaining and instructive, and at its close Mr. Boucicault received the cordial thanks of the house.

Our Mathematical Column.

EASY LESSONS IN THE DIFFERENTIAL CALCULUS.

No. VI.

By Richard A. Proctor.

We have now to establish rules for dealing with composite functions, and functions of functions.

First let us take composite functions—viz. (i.), the sums and differences of functions, (ii.) the products of functions, (iii.) functions divided by functions.

I. Let $u = v + w - y + z$, &c., where v, w, y, z, &c., are all functions of x; and when x is altered into $(x + \Delta x)$, let u be altered into $(u + \Delta u)$, v into $(v + \Delta v)$, w into $(w + \Delta w)$, &c. Then

$$u + \Delta u = (v + \Delta v) + (w + \Delta w) - (y + \Delta y) + (z + \Delta z) + \&c.$$

Hence, subtracting the former equation from the latter—

$$\Delta u = \Delta v + \Delta w - \Delta y + \Delta z + \&c.$$

and dividing both sides by Δx, we have

$$\frac{\Delta u}{\Delta x} = \frac{\Delta v}{\Delta x} + \frac{\Delta w}{\Delta x} - \frac{\Delta y}{\Delta x} + \frac{\Delta z}{\Delta x} + \&c.$$

Now, suppose Δx to become indefinitely small, so that $\frac{\Delta u}{\Delta x}$, $\frac{\Delta v}{\Delta x}$, $\frac{\Delta w}{\Delta x}$, $\frac{\Delta y}{\Delta x}$, $\frac{\Delta z}{\Delta x}$, &c., become the differential coefficients of u, v, w, y, z, &c., with respect to x. Then we have

$$\frac{du}{dx} = \frac{dv}{dx} + \frac{dw}{dx} - \frac{dy}{dx} + \frac{dz}{dx} + \&c. \qquad (A)$$

II. Let $u = y\ z$; y, z, as before being functions of z, and the

same changes taking place in u, y, z, when x is changed into $x+\Delta x$. Then,

$$u+\Delta u=(y+\Delta y)\ (z+\Delta z)$$
$$=yz+z\Delta y+y\Delta z+\Delta z\Delta z$$

and subtracting former from latter

$$\Delta u=z\Delta y+y\Delta z+\Delta y\Delta z$$

and
$$\frac{\Delta u}{\Delta x}=z\frac{\Delta y}{\Delta x}+y\frac{\Delta z}{\Delta x}+\frac{\Delta y\Delta z}{\Delta x}$$

Now when Δx is made indefinitely small, this becomes

$$\frac{du}{dx}=z\frac{dy}{dx}+y\frac{dz}{dx}+\frac{dy}{dx}.\ \text{(an indefinitely small quantity)}$$

or
$$\frac{du}{dx}=z\frac{dy}{dx}+y\frac{dz}{dx}$$

And in like manner it may be shown that

if $u=vwyz\ \ldots\ .$

$$\frac{du}{dx}=wyz\frac{dv}{dx}+vyz\frac{dw}{dx}+vwz\frac{dy}{dx}+vwy\frac{dz}{dx}+\&c. \qquad (B).$$

III. Let $u=\frac{y}{z}$, y and z being functions of x. Then—

$$u+\Delta u=\frac{y+\Delta y}{z+\Delta z}=\frac{y}{z}\left(1+\frac{\Delta y}{y}\right)\left(1+\frac{\Delta z}{z}\right)^{-1}$$
$$=\frac{y}{z}\left(1+\frac{\Delta y}{y}\right)\left(1-\frac{\Delta z}{z}+\text{terms involving }(\Delta z)^2\ \&c.\right)$$
$$=\frac{y}{z}+\frac{\Delta y}{z}-\frac{y.\Delta z}{z^2}$$
$$+(\text{terms involving }\Delta y.\Delta z,\ \Delta z^2,\ \&c.)$$

$\therefore$ Subtracting, $\Delta u=\frac{\Delta y}{z}-\frac{y\ .\ \Delta z}{z^2}+(\text{terms involving }\Delta z^2,\ \&c.)$

and
$$\frac{\Delta u}{\Delta x}=\frac{1}{z}\cdot\frac{\Delta y}{\Delta x}-\frac{y}{z^2}\cdot\frac{\Delta z}{\Delta x}+(\text{terms involving }\Delta z^2,\ \&c.)$$

so that proceeding to the limit,

$$\frac{du}{dx}=\frac{1}{z}\frac{dy}{dx}-\frac{y}{z^2}\frac{dz}{dx} \qquad (C.)$$

Take next the function of a function. Suppose, for instance, that $u=\phi(y)$, where y is a function of x. Let y change to $y+\Delta y$ when Δy is some small but finite increment, and with this change let u become $u+\Delta u$, and x become $x+\Delta x$. Then we have

$$u+\Delta u=\phi(y+\Delta y)$$
$$\Delta u=\phi(y+\Delta y)-\phi(y)$$

and
$$\frac{\Delta u}{\Delta x}=\frac{\phi(y+\Delta y)-\phi(y)}{\Delta x}$$
$$=\frac{\phi(y+\Delta y)-\phi(y)}{\Delta y}\cdot\frac{\Delta y}{\Delta x}$$

Now let Δy become indefinitely small, Δu and Δx becoming also indefinitely small. Then $\frac{\phi(y+\Delta y)-\phi(y)}{\Delta y}$ becomes $\frac{du}{dy}$, in accordance with our definition of a differential coefficient, and the above equation becomes

$$\frac{du}{dx}=\frac{du}{dy}\cdot\frac{dy}{dx} \qquad (D)$$

If we note that relation (C) may be written thus,

$$\frac{du}{dx}=\frac{1}{z}\cdot\frac{dy}{dx}+y\frac{du}{dx}$$

(a relation not apparent until D had been established) we see that relations A, B, and C may be combined into the first of the following rules, while D gives the second:—

Rule I.—*To determine the differential coefficient of a composite function of a variable, with respect to this variable, differentiate each component function with respect to the variable, as if the rest were constant, and add the results.*

Rule II.—*To determine the differential coefficient of a function of a function of a variable, with respect to this variable, differentiate with respect to the last-mentioned function, and multiply the result by the differential coefficient of this function with respect to the variable.*

It is hardly necessary to note that *the differential coefficient of a constant is zero*, for this is only another way of saying that a constant does not vary. It is also clear that *if the differential coefficient of a quantity is zero, the quantity must be constant*, for this is only saying that a quantity which does not vary is constant. It is, moreover, independently obvious, but comes out directly from Rule I., that *if the differential coefficient of a quantity is known, then the differential coefficient of the quantity multiplied or divided by a constant is the former differential coefficient multiplied or divided by the same constant.*

We had occasion some time back to note that *two quantities which have the same differential coefficient can only differ by a constant quantity*. We can now prove this. For let there be two quantities y and z, both functions of a variable x, which have the same coefficient with respect to x; so that

$$\frac{dy}{dx}=\frac{dz}{dx}$$

Then if $y-z=u$, we have, by Rule 1,

$$\frac{du}{dx}=\frac{dy}{dx}-\frac{dz}{dx}=0$$

wherefore u is a constant,—*i.e.*, since $u=y-z$, y can only differ from z by a constant quantity.

In our next we shall give some examples of differentiation by these rules.

Problem 30.—A solution which has been suggested to me of Query No. 30, page 323, vol. i., I give below:—

$x^2+y=11$
$y^2+x=7$
$\therefore\ x^2+y^2+x+y=18$ to this add and subtract $2xy$
$x^2+y^2+2xy+x+y=18+2xy$

and $x^2+y^2+2xy+x+y=18-2xy\left(\begin{matrix}\text{let } x+y=s\\ x-y=a\end{matrix}\right)$

add: $s^2+2s+a^2=36$

36 being a square number s^2+2s+a^2 must be a square or a^2 must equal 1; wherefore $s+1=6$.—F. H.

[Why does it follow that because s^2+2s+a^2 is a square, $a^2=1$? $4^2+2\times4+5^2=49=7^2$, and these are all whole numbers: x and y might be fractional.—Ed.]

A mathematical correspondent (Mr. F. Cowley) asks me to explain why, after saying, at p. 101, col. 2, that at the beginning of the rth interval the velocity is $(r-1)\,g\tau$, and at the end of that interval the velocity is $rg\tau$, I go on to say that the space described in the interval lies between $(r-1)\,g\tau^2$ and $rg\tau^2$. He says this seems to be assuming what I have to prove, "though in reality the space so traversed is in reality $\frac{1}{2}rg\tau^2$." There is no assumption in the matter, however; the space described in a given time, t, with uniform velocity, v, is vt; so that the space described in time τ, with velocity $(r-1)\,g\tau$ is $(r-1)\,g\tau^2$, while space described in time τ, with velocity $rg\tau$, is $rg\tau^2$; we know that the space described in the rth interval (τ in length of time) lies between these values, because the velocity, is never less than $(r-1)\,g\tau$ during the interval, and never greater than $rg\tau$. Our correspondent seems to confound in some way the space described *at the end of* the rth interval with the space described *during* the rth interval. The former is of course $\frac{g}{2}(r\tau)^2$ (by the usual formula $s=\frac{1}{2}ft^2$. The space described during the interval is in reality

$$\frac{g}{2}\Big[(r)^2-(r-1)^2\Big]\tau^2=\frac{g}{2}(2r-1)\tau^2$$

Writing this $g\,(r-\frac{1}{2})\tau^2$ we see that it lies, as a matter of fact, just half way between the two limiting values mentioned above and in the text. In most cases where limits are mentioned in this way, all that we can assert at first is that the quantity dealt with lies somewhere between the limits mentioned, not that it lies, as it happens to do in this case, exactly midway between them.

The same correspondent asks how, after showing that the space traversed lies between two quantities, I can reasonably say that in the limit these two quantities are equal. "How can a quantity lie between two equal quantities?" I fear if Mr. Cowley finds difficulty here, the whole subject will appear very perplexing to him. Of what use would it be to show that a quantity which we want to determine exactly lies between two quantities which ultimately differ by a finite quantity? If we can show that a quantity always lies between two others, B and C, which may be written $A+a$ and $A-a'$, while both the quantities a and a' may be made, under certain conditions, less than any assignable quantity, *then*, and then only, we can say that under those conditions $X=A$? Why should we find any difficulty in the circumstance that under these conditions $B=C=A$?

Problem.—To integrate $d\theta=\left(\frac{4v^2+3}{v^2+1}\right)dv$.

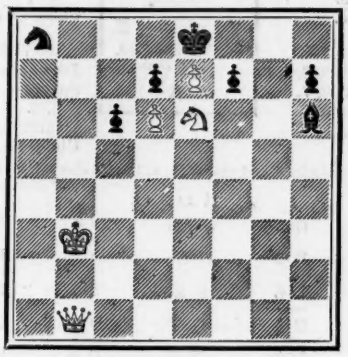
Our Chess Column.

By Mephisto.

PROBLEM No. 49.

By Leonard P. Rees.

BLACK.



WHITE.

White to play and mate in two moves.

GAMES BY CORRESPONDENCE.

WE hope our correspondents will not think we have either forgotten or neglected them. We are as eager as ever to please them, but exigencies of space prevented us from doing all we wished to do. We clear up some of our arrears in publishing this week some happy specimens of games played by Correspondence through the medium of our journal:—

BETWEEN MR. E. P. WESTLAKE, OF (WOOLSTON) SOUTHAMPTON, AND MR. E. A. DILLON, OF LONDON.

King's Gambit.

White. E. P. W.	Black. E. A. D.	White. E. P. W.	Black. E. A. D.
1. P to K4	P to K 4	10. B takes Kt	B takes B
2. P to KB4	P takes P	11. B takes P (ch)	K to Qsq
3. Kt to KB3	P to KKt4	12. P to K5	R to Bsq
4. B to B4	B to Kt2	13. Kt to B3	Kt to B3
5. Castles	P to Q3 (*a*)	14. Q to Q5 (*d*)	B to K6 (ch) (*e*)
6. P to B3 (*b*)	P to Kt5	15. K to Rsq	Q to Kt4
7. P to Q4	P takes Kt	16. R to B6 (*f*)	Kt to K2 (*g*)
8. Q takes P	Kt to KR3 (*c*)	17. R takes P (ch)!	Resigns (*h*)
9. QB takes P	Q to K2		

NOTES.

(*a*) 5. P to KR3 deserves a slight preference.
(*b*) 6. P to Q4 is better.
(*c*) We prefer 8. B to K3.
(*d*) Well played; White now has a strong game.
(*e*) Useless. B to Q2 might have proved better.
(*f*) Playing in fine style, he threatens R takes P (ch), &c.
(*g*) Even now B to Q2 would have saved Black from impending ruin.
(*h*) The position is interesting. The following would be the termination if continued:—17. P takes R; 18. Q takes P (ch), B to Q2; 19. B to K6, and mate is inevitable. Or, if Black does not take the Rook, but plays 17. B to Q2, then 18. R takes B (ch), K to Bsq; 19. R to Q8 (ch), R takes R; 20. B to K6 (ch), K to Kt sq, and mate in two.

BETWEEN MR. G. WOODCOCK, OF HYTHE, AND MR. G. FREEMAN, OF LONDON.

French Defense.

White. G. W.	Black. G. F.	White. G. W.	Black. G. F.
1. P to K4	P to K3	9. R to Ksq	P to KR3
2. P to Q4	P to Q4	10. B to KB4	P to QR3 (*c*)
3. Kt to QB3	Kt to KB3	11. Q to Q2	B to K3 (*d*)
4. P takes P	P takes P	12. B takes KRP	P takes B
5. Kt to B3	B to Q3 (*a*)	13. Q takes P (*e*)	Q to Q2 (*f*)
6. B to Q3	Castles	14. Kt to K5	Kt takes Kt (*g*)
7. Castles	Kt to B3	15. R takes Kt	Resigns (*h*)
8. B to KKt5	B to K2 (*b*)		

NOTES.

(*a*) 5. B to K2 is better for the second player.
(*b*) As good as B to K3.
(*c*) Useless. In a match game, Gunsberg here played against Blackburne B to KKt5.
(*d*) Not foreseeing White's lurking enterprise.
(*e*) With a good game.
(*f*) If 13. Kt to QKt5 with the object of dislodging the B, White wins by 14. R to K5.
(*g*) If Q retires, then 15. R to K3.
(*h*) Having no resource left against White's good play.

BETWEEN MR. A. B. PALMER, OF PENGE, AND MR. G. WOODCOCK, OF HYTHE.

White. A. B. P.	Black. G. W.	White. A. B. P.	Black. G. W.
1. P to QR3 (*a*)	P to Q4	15. Kt to Q6	Kt to K4
2. P to QB3 (*b*)	P to K4	16. Kt to B5	P to QR4
3. P to K4	P to QB3 (*c*)	17. Castles	P to QB5
4. P to Q3	Kt to KB3	18. P takes P	Kt takes P (*e*)
5. B to Kt5	B to K2	19. P to K5 (*f*)	Kt takes KP
6. B takes Kt	B takes B	20. B takes R	Q takes B (*g*)
7. Kt to Q2	Castles	21. K to R2 (*h*)	Kt to B6 (ch)
8. KKt to B3	P to Q5	22. K to R3	Q to K5
9. P takes P	P takes P	23. Kt to K3 (*i*)	P takes Kt
10. P to KR4	B to Kt5	24. P takes P	Kt takes RP
11. P to KKt3	P to QB4	25. R takes B	P takes R
12. B to K2 (*d*)	B takes Kt	26. P takes Kt	Q takes KP (ch)
13. B takes B	Kt to Q2	27. K to Kt4 (*j*)	K to Rsq
14. Kt to B4	P to QKt4	28. Q to Q6	Black mates in four moves (*k*)

NOTES.

(*a*) Permissible, if soon followed up by P to K4 and QB4.
(*b*) This at once puts White at a disadvantage.
(*c*) Black ought to have taken the Pawn—*i.e.*, 3. P takes P; 4. Q to R4 (ch), Kt to QB3; 5. Q takes KP, Kt to KB3, with a good development.
(*d*) We prefer 12. B to R3.
(*e*) Black has steadily developed his game on the Queen side, but now he would have done better to play P takes P. White cannot capture the KP on pain of losing a piece, for if Kt takes P, then Q takes Kt.
(*f*) White wins the exchange, but Black probably foresaw this.
(*g*) He now occupies a commanding position. The White Knight cannot take the Pawn, as Black would win the piece by R to Qsq.
(*h*) This is weak. P to B3 or B4 would have been better, to which Black might have replied with Kt to B5.
(*i*) This Knight cannot be defended by Q to Kt sq, as P to Q6; but he would have saved the piece by Kt to Q6, but then Black would have played 12. Q to K3(ch), K to Kt2; 25. Kt takes RP (ch), followed by Q takes Kt, with a good game.
(*j*) Into the lion's mouth.
(*k*) By R to Kt sq (ch), K to B4; Q to B6 (ch), Q to B4; Q to Q4 (ch), and mate next move.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

From Squire.—We shall not use the small diagrams for original problems any more; only for copies. Glad you are pleased.

Alfred B. Palmer.—Problem received with thanks. Can you send a game you have won?

Belmont.—Of course you know that a forced mate is required, which you get by 1. R to Q7 (ch).

A. A. Dent.—Solutions incorrect.

A. A. B.—Such a thing happened to us before with one of your games, for which we had actually paid a fee; but we by no means grumble at the praiseworthy enterprise of our contemporary.

Leonard P. Rees.—Thanks for problem. Hope soon to have an opportunity of pronouncing an opinion upon 10. Castles.

Correct solutions of Problem No. 46 received from Alfred B. Palmer, Kit, Berrow.

Problem No. 47.—Belmont, Herbert Jacobs, Berrow, Alfred B. Palmer, Kit.

Problem No. 48.—Leonard P. Rees, Belmont, Alfred B. Palmer, Squire, John Percy Isaac, Berrow, C. W. Croskey, B. Pierce, A. H. Cooke, John Watson, M. Beyfus, J. J. Kaye, E. J. J.

XUM

Our Whist Column.

PLAY THIRD IN HAND (TRUMPS).

THE play third in hand, in trumps, varies often importantly from the play in plain suits, though it is not easy to lay down general rules for determining the difference. Usually, when you play trumps third in hand, the suit has either been led by your partner originally, or he returns your own lead of trumps. You are playing together, in this case, to draw trumps and bring in a long suit. It is therefore often more important to keep the lead than to gain a trick by finessing, so that beyond the customary finesse from Ace, Queen (third in hand), you would avoid finessing early in the play of trumps, especially to your partner's original lead of trumps. On the other hand, you can finesse more safely in trumps than in other suits, for a winning card is sure to make. And again in the third round of trumps it may often be well to pass the trick, even when second in hand has headed it, or when fourth in hand is sure to take it, so as to secure the last trick in trumps. These matters depend so much on previous indications from the play, on the nature of the hand outside trumps, and so forth, that it is impossible to lay down general rules: the best way of indicating correct principles of play is to give illustrative hands for study. It need hardly be said that the trump card has to be taken carefully into account in considering what to play third in hand. It not only alters often the finesse into sure play, as when King has been turned up on your right and you hold Ace, Queen, third in hand; but it may make a finesse sound which otherwise would be unsound. Thus to finesse the Knave third in hand from Ace, Knave, with or without others, would be usually unsound; but if Queen or King is turned up on your right, it is sound, as you finesse against one card only, and if the finesse fails retain the command. (Note, in passing, that when trumps have been originally led by yourself, it is often sound to finesse against more than one card.) If your partner has turned up King or Queen and leads a small trump, the finesse from Ace Knave is not so well, for in that case your partner probably does not hold both King and Queen, and, if second hand plays a small card, the odds are rather in favour of either King or Queen being on your left. With King, Knave, &c., to your partner's original lead of trumps, finessing the Knave is inexcusable. Of course, if Queen is turned up on your right, or by your partner, you would play the Knave; but that, equally of course, would not be a finesse.

In all cases, in plain suits as well as in trumps, finessing third in hand must depend on the score. If the failure of the finesse in plain suits would lose the game, a finesse is inexcusable; it is scarcely better, if failing would leave you at the score of two instead of three, or lose instead of gaining you the odd trick. On the other hand, if the failure of the finesse would leave you the odd trick instead of three, while its success would leave you at the score of three, it is nearly always right to finesse, even when the odds are rather against than in favour of success.

In our next we shall consider the inferences from play third in hand, as we have already considered the inferences from the lead, from play second in hand, &c.

EASY END GAME.

A holds:
Spades—9, 6.
Diamonds—Kn, 5.

B holds:
Spades—5, 2.
Diamonds—10, 3.

Y holds:
Spades—10, 8.
Hearts—9, 7.

Z holds:
Spades—Q, 3.
Hearts—4, 2.

Score:— { *A*, *B*, = 4 / *Y*, *Z*, = 2

Two honours have been played by *Y Z*, one honour by *A*, so that *Y Z* hold two by honours, to *Z*'s knowledge. *A B* have turned six tricks.

A having led Diamond Knave, how is *Z* to play to save and win the game?

DOUBLE DUMMY PROBLEM (p. 104).

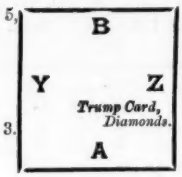
WE have received two forms of solution to this problem, which requires, be it remembered, that the adversaries should have four by honours in every suit, yet that five by cards should be won against them.

First, sent by one correspondent only (unfortunately his name or initials not appended to the solution itself, though accompanying his letter—mislaid) runs as follows:—

THE HANDS.

A.
Diamonds—9, 7, 2, 5.
Clubs—10, 9, 8, 7, 6, 5, 4, 3, 2.
Hearts—None.
Spades—None.

B.
Diamonds—10, 8, 6, 4, 3.
Spades—10, 9, 8, 7.
Hearts—10, 9, 8, 7.
Clubs—None.



Y.
Diamonds—K, Kn.
Spades—K, Kn.
Hearts—K, Kn, 6, 5, 4, 3, 2.
Clubs—K, Kn.

Z.
Diamonds—A, Q.
Spades—A, Q, 6, 5, 4, 3, 2.
Hearts—A, Q.
Clubs—A, Q.

NOTE.—The underlined card wins trick, and card below it leads next round.

A to lead.

1.	C 2	C Kn	D 3	C Q
2.	D 2	D Kn	D 4	D Q
3.	D 5	S Kn	S 7	S 2
4.	C 3	C K	D 6	C A
5.	D 7	D K	D 8	D A
6.	D 9	H Kn	H 7	H A

Then *A* brings in his Clubs, *Y* and *Z* playing any cards whatever, and *B* retaining the long trump till the thirteenth trick. It is obvious that *Y* and *Z* are powerless. If *Z* leads Diamond Ace at trick 3, the order of tricks 3, 4, and 5 is simply changed, but the result remains the same. So also if *Z* leads a Heart or a Club at trick 3 instead of a Spade.

The other solutions, sent by J. Hargreave, T. Parminter, Loresmith, M. Vindex, H. H. Hamilton, and others, we shall give next week.

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